Diffusion Tensor Imaging and Tractography in the Rhesus Macaque Brain

Elizabeth Zakszewski

Under the supervision of Andrew L. Alexander, PhD.

At the University of Wisconsin-Madison

June 28, 2013

Abstract

Diffusion tensor imaging (DTI) tractography is a tool for noninvasively mapping and probing the microstructure of white matter (WM) in the brain. It has great potential for use in studies of brain connectivity analyses including models of psychiatric disease. However, the validity of tractography for mapping the true underlying brain connections has not been clearly established. The rhesus macaque (*Macaca mulatta*) is a nonhuman primate species that may be studied both in-vivo and ex-vivo, making it a good translational model in these studies to provide anatomical validation of brain imaging methodologies. It is also a good neurological model of the human brain and is widely used in behavioral studies, making it useful for validating and investigating reconstructions of brain connectivity. While there are a growing number of DTI studies of brain microstructure in the rhesus macaque, the field is still lacking a standardized template of white matter regions for application in brain imaging studies in the rhesus monkey. This work evaluates and applies DTI tractography reconstructions of white matter tracts and to create an atlas of major white matter regions in the rhesus monkey. Specifically, it provides an in-depth look at how accurately probabilistic DTI tractography can trace the same WM pathways that have traditionally been visualized with histological tracers, demonstrates applications of the same tractography methods for analyzing a connectome hub in the brain, and presents a completely novel atlas of WM structures in the rhesus that can immediately be applied to studies of many neuropsychiatric conditions.